

# **Big Meadows Creek Restoration Project**

## **Final Program Report**

*Project Dates 2004 to 2009*



## **Fly Fishers for Conservation**

Jayne Ferrante, Project Manager

*In Collaboration with:*

**Sequoia National Forest, US Dept. of Agriculture**

**National Fish & Wildlife Foundation, Jackson Hole One-Fly**

**Sierra Nevada Conservancy**

**California State University Fresno, Department of Earth Sciences**

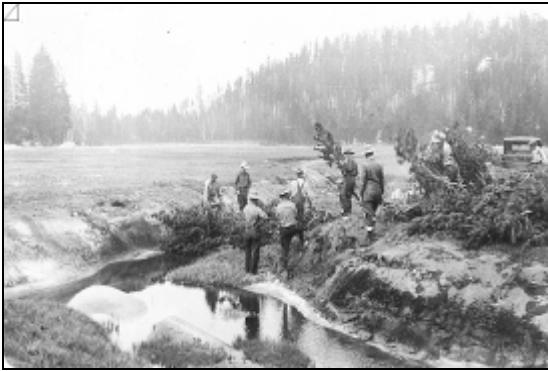
**Federation of Fly Fishers, Northern California**

**Federation of Fly Fishers, Southwest Council**

**Ted Martin Foundation**

**Kings River Conservation District**

**California Dept. of Fish and Game**



Restoration efforts in Big Meadows circa 1934, (courtesy of Forest Service)

## Executive Summary

*This project is an effort with four stages. First funded and executed was research in the form of a Master's Thesis to develop both the student's abilities and project baselines. Next was more data gathering with restoration design work, and implementing the project. Then the project was analyzed and training provided to watershed professionals in an effort to teach them how to identify appropriate meadows that could be treated effectively utilizing this technique, how to evaluate and lay out a design, implementation issues, and how to apply the NEPA and CEQA process. Finally ongoing monitoring will document both our progress on the ground and alert us to any potential onsite needs to address.*

## Introductory Background

In 2003 Fly Fishers for Conservation (Fresno California) received funds from member Ted Martin to accomplish a conservation project. These funds provided the “seed” money to develop the Big Meadows restoration project. Local members suggested a high Sierra meadow they had fished since the early 1970's and watched the stream degrade and fish disappear over the 30 years they had fished there. Big Meadows is the ideal teaching stream. Jayne Ferrante, First Vice President of FFC, contacted CSU Fresno to develop a collaborative effort and ultimately we funded student Jason Olin to focus on Big Meadows problems and solutions as his Master's thesis. This thesis provided the scientific research to design and implement an intervention to re-water the meadow.

Dr. Roland Brady, Engineering Geologist and professor at CSU Fresno suggested collaborating with Jim Wilcox, an innovative practitioner from Plumas County who had developed a holistic meadow re-watering technique based on Rosgen theory, then pioneered and refined its use restoring meadows in the Feather River drainage for the past 14 years. Mr. Wilcox became an integral element supervising and teaching in this restoration project and guiding our efforts to increase technical and institutional capacity in the Southern Sierra.

During September 2007 the project was installed. The third element of the project was to utilize this work as a demonstration site for the technique used. This meadow re-watering technique is euphemistically referred to as ‘pond and plug’ and is discussed further in the

introduction. This technique has rapidly been gaining acclaim in recent year in Northern California, but the Southern Sierra has had no one working on meadow restoration as well as not utilizing this efficient and cost effective technique.

In 2008 we held a 5 day course for watershed professionals from various State, Federal, non-profit and for-profit agencies and companies. This course was an integral element of accomplishing our agenda for this region. One of our stated goals was to develop institutional and technical capacity in the Southern Sierra. We also sponsored a local geologist to work with Mr. Wilcox for 30 days on a project in the Feather River. Additionally we will continue monitoring and reaching out to watershed professionals locally. A timeline is attached further in the report for clarity of the project's evolution.

## **Big Meadows Site History and description**

Big Meadows is a high elevation (2317 m, approximately 7600 ft. MSL) meadow in the Sequoia National Forest located in Tulare County, CA. Big Meadows Creek flows in a northwesterly direction across the meadow towards its confluence with the Kings River in Kings Canyon National Park. The stream drains a 28 km<sup>2</sup> granitic floored watershed in the southern Sierra Nevada Mountain Range. Since the late 1800s the Big Meadows area was used for seasonal grazing of sheep and cattle under private ownership. In the early 1900s the area was acquired by the federal government. The first recorded grazing allotment under Forest Service jurisdiction was created in the early 1960s. According to Hume Lake Ranger District personnel (Roche personal comm. 2006) and district records the initial check dams were installed at the time the allotment was issued. A map from 1941 shows some gullying in the meadow, and according to stream gauge records from Cedar Grove on December 23, 1955, there is evidence of a rain-on-snow event, which likely increased the gullying in Big Meadows. This same event caused massive flooding in several valley towns. The USGS monthly streamflow statistics for Cedar Grove on the Kings River were 947 cubic feet/second, with a mean December flow of 308 cubic ft/sec (average from 7 years). The Trimmer gauging station downstream was in operation for over 55 years and that December was the highest flow on record with 3,387 cubic ft/sec, and a mean flow for December 1955 of 487 cubic ft/sec. (USGS Monthly Streamflow Statistics 11213500 Kings R AB NF NR).

As was intended during their installation approximately 30 years ago, the 1980s check dams have effectively built up sediment behind them (upstream) and raised the stream grade, but the stream channel between them remains downcut. This condition concentrates flood flow resulting in accelerated erosion which impacts aquatic habitat. The streambed elevation and water table in the meadow remained approximately 2.5- 4.0 feet lower than the historic floodplain. The lower streambed elevation was draining the meadow of groundwater. This means the plant community on the upper terrace now favors more dry upland plants than the plant community on the lower surfaces closer to the water table surface. The lowering of the water table has led to encroachment of upland plants such as lodgepole pine, and colonization by invasive species. Nearly the entire channel through the check dam treatment area had a flat bottom without a defined channel. The substrate is sandy, and vegetation consists solely of aquatic grasses. These conditions provide poor habitat for aquatic species due to the mobile substrate and lack of in-stream cover and shading.

## Big Meadows June 2004 Pre-Restoration



Lower reach, eroded & trampled banks, failed gabion.



Upper reach, eroded banks



Upper reach, eroded banks



Upper Peizometer Looking upstream





Lower reach. Typical rock-gabion weir with ponded sediment upstream creating marsh

## Big Meadows Site Map



Google Earth image of Big Meadows showing project monitoring features. Note: PZ= Piezometer.

**Table 1. Big Meadows Project Features.**

Feature	Lat (deg N)	Long (deg W)	Comments
Stream Gage	36 42.932	118 49.990	Pressure Transducer, Campbell Scientific CR 510 Data logger, and staff gage
Valley Grade Structure	36 42.937	118 50.056	Compacted Rock Fill
“Lower” Piezometer	36 42.868	118 50.132	¾ inch galvanized riser with drive point screen
“Middle” Piezometer	36 42.646	118 50.219	Same as “Lower”
“Upper” Piezometer	36 42.626	118 50.622	Same as “Lower”
Big Meadows Snow Sensor	36 42.923	118 50.629	CA Cooperative Snow Survey Site
BIM Station Temp/Precip			CDEC, Precipitation and Temperature

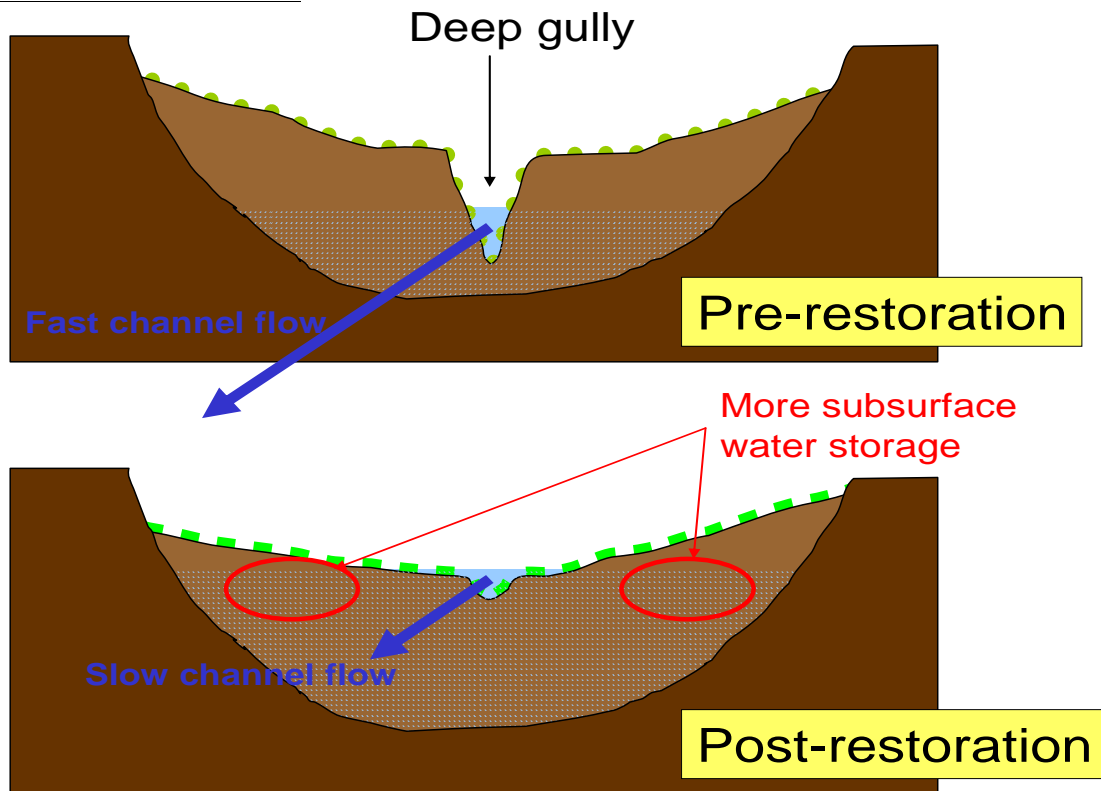
## Technique description

The Meadow was restored utilizing a holistic re-watering method euphemistically referred to as “pond and plug”. The restoration took highly incised (down cutting) stream channel segments and filled them with soil and rock (plugs) from alluvium excavated within the floodplain of the meadow. The excavated areas form ponds on the floodplain which are filled via the restored groundwater table. The surface flow is connected by a low gradient, remnant stream channel system. The project is expected to provide the following ecosystem benefits: 1) establish a primary-thread low flow channel with multiple ancillary channels, 2) reduce flow peaks and increase/extend summer base flows, 3) increase in-stream cover and shading, 4) enhance aquatic and terrestrial habitat, 5) improve water quality, and 6) raise local groundwater level within the meadow (USFS, 2006).

The general objective of the restoration project is to restore Big Meadows ecosystem functions and associated riparian and aquatic habitat while maintaining existing land uses such as recreation and grazing.

Care is taken to tie elevation and sinuosity to the meadows own geomorphology, allowing it to find its homeostasis. Reduced incident of failures are a benefit of this approach.

**Restoration Schematics:**



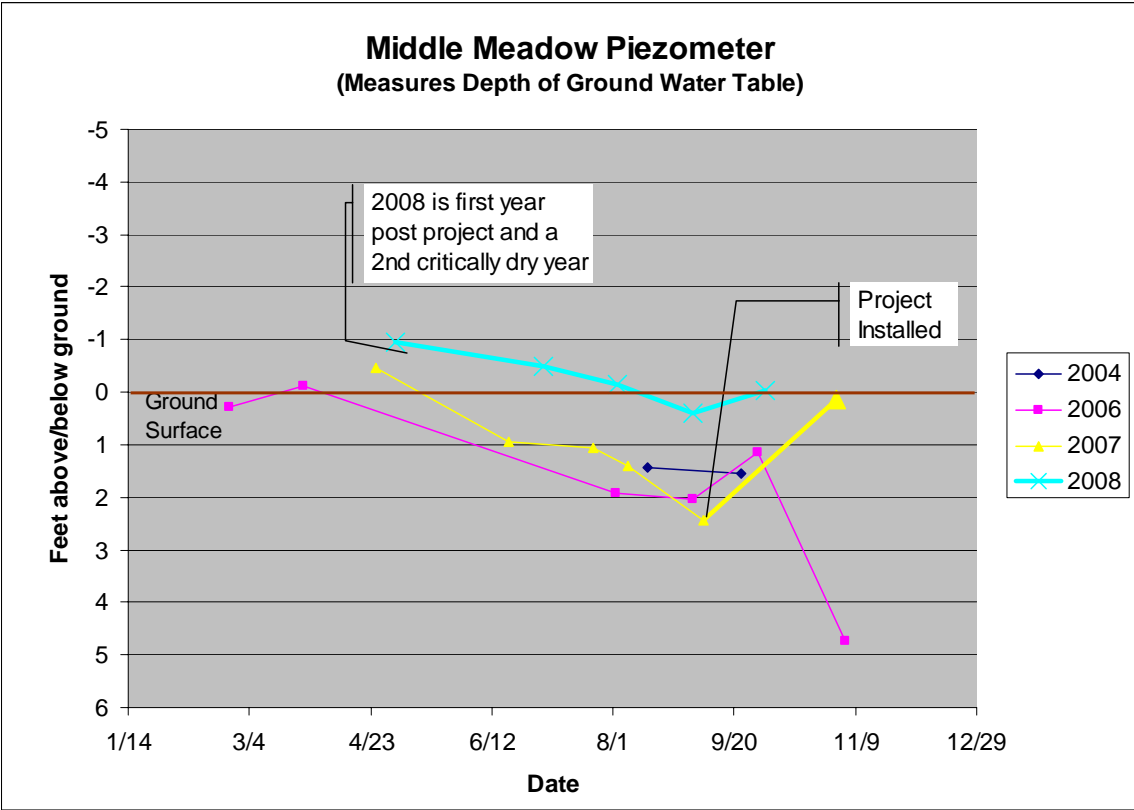
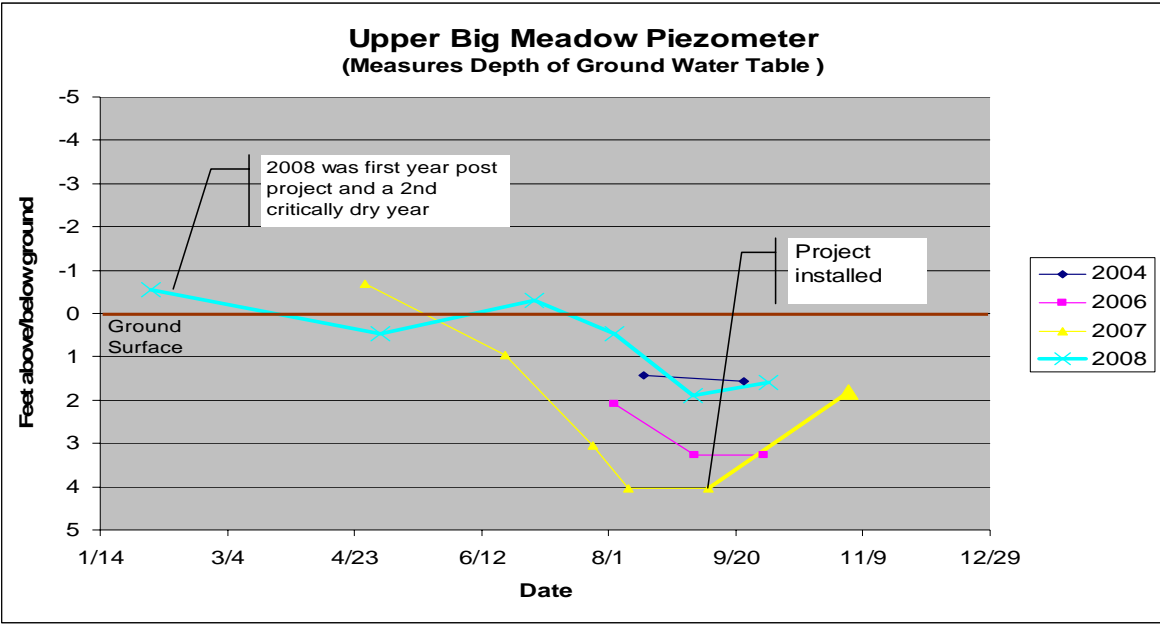
# Monitoring

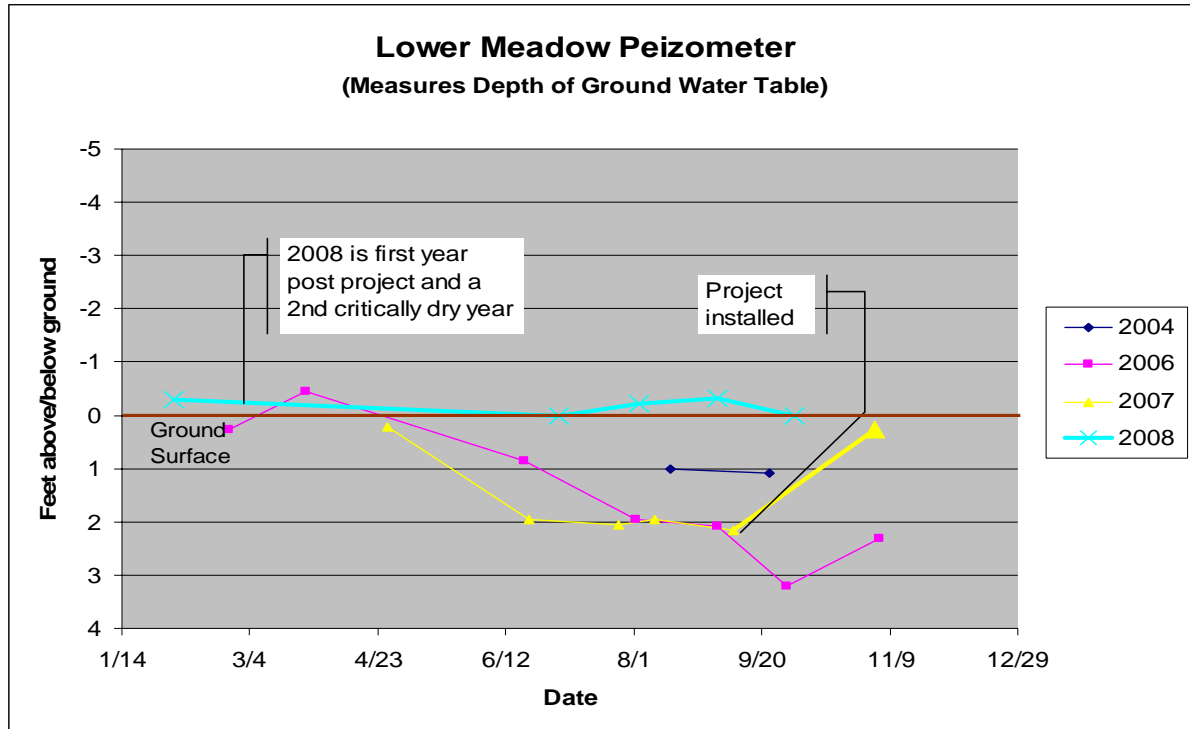
*Several monitoring efforts are ongoing in the meadows.*

- First, ground water table levels are recorded from piezometers. Initial levels were captured in the Fall of 2005 during the thesis work.
- Second a Datalogger was installed below the project in December of 2006 prior to the installation. We present this information below, but require additional years of data for any conclusions.
- Third, we are producing a study of “Benthic Macroinvertebrate Populations in Big Meadows Pond and Plug Restoration”. This study will establish macroinvertebrate populations in the year following restoration and to continue to monitor the changes in populations in subsequent years. Audra Horner, of Kings River Conservation District was awarded this study with the intention of using it as her Master’s Thesis at CSU Fresno. Unfortunately Audra’s position was eliminated with State of California cuts this year. Baseline samples were collected October 2008, and will be compared annually based on the study outline, attached. KRCD staff Louie Long has stepped in for Audra. Water Temperature in the Ponds is being collected via Hobo temps. This was established in October 2008, and will be collected annually and plotted.
- Avian study was performed by Jeff Cordes, Biologist for Sequoia National Forest. The report is attached as an addendum. Very little baseline data was collected in the thesis by Olin, therefore comparison to similar meadow habitats was used.
- Hydrogeologist Stephen Lee was hired for the 2008 year to monitor the project. His draft report is attached. Irregularities in the report and the inability to correct these make this report only available as a draft. The majority of his work is considered to be very good. The draft report is attached.
- Sequoia National Forest completed a new survey of the meadow post project and will compare this annually. A Stream Condition Inventory was completed post project 2008 and in 2009 and will continue.
- Sequoia National Forest also completed a range plot inventory in 2009.



# Peizometer Monitoring Data

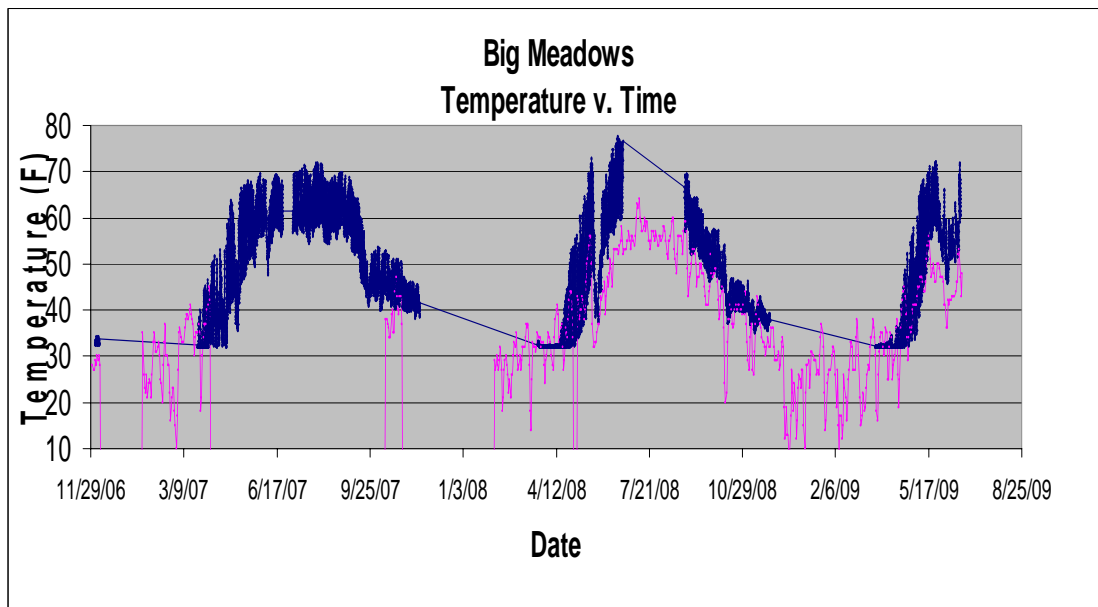




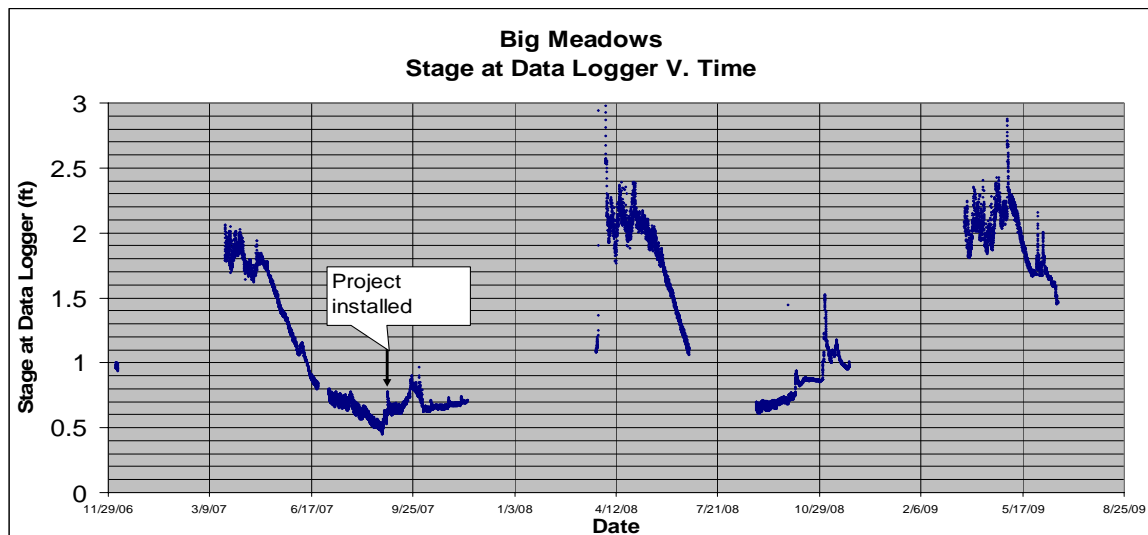
**Love that Spring Monitoring!**

Fly Fishers for Conservation  
Fresno, CA 559-437-1818

## Datalogger Monitoring Data



This Data logger data is presented to indicate the type of monitoring ongoing. Not enough data has been collected in order to make any quantified assessment. This data will continue to be analyzed using difference between air and water temperature as our variable once air temp is acquired and more years of data collected. Air temp acquired from the state (shown in pink), has significant gaps. Past projects have usually shown 3 years for the time frame to notice benefits in water temperature.



This Data logger data is presented to indicate the type of monitoring ongoing. Not enough data has been collected in order to make any quantified assessment. Note that during the time the probe is frozen no data is collected. June and July of 2008 data was lost. This data will be valuable after 2009 is collected, and volume is calculated.

## Photopoint Monitoring Data

### Aerial



This is an aerial shot of the meadow 3 days before completion Oct 2, 2007.

Note the filled gully on the left side of the valley. Filling this downcut gully will allow water to flow back into its original channel(s).



This is an aerial shot of the meadow November 2007. Ponds are filling phreatically from reduced transpiration. No rain event had occurred yet.



This is an aerial shot of the meadow November 2007. You can see that water has collected in the ponds from transpiration. No rain events had occurred yet.

**November 17 2007**  
One month post project



Upper Meadow



Mid Meadow



Lower Meadow



**July 6, 2008**

One year post project



Lower photopoint



Middle photopoint



Upper photopoint

**July 25, 2009**

Second season post project



Lower photopoint  
July 25, 2009



Middle photopoint  
July 25, 2009  
Notice the stream  
channel beginning to  
establish in comparison  
to the year before.



Upper photopoint  
July 25, 2009

## **Project Timeline**

### **Spring / Summer 2004**

- Data collection
- Comprehensive field study

### **Spring 2005**

- Data analysis & interpretation
- Program development, grant proposals, partial funding

### **Fall/ Winter2005**

- Jason Olin Thesis published, SERCAL presentation
- October Stakeholder walk
- Stakeholder meetings and resolution: October 2005
- Complete ground review with Jim Wilcox
- Jayne Ferrante receives training on grant proposal writing and grant management from Plumas Corporation staff.
- Fund raiser for Big Meadow (Fly Fishing Team USA)
- Coordinated with Sequoia National Forest NEPA process
- Nordic Ski club and Fly Fishing Club members help collect data all winter in the Meadow
- Grant writing efforts to fund the project.

### **Spring 2006**

- June: Stakeholders conducted cross section surveys in the meadow, expanding our data. Terry Henry, Sequoia National Forest Hydrologist and Jim Wilcox, Plumas Corp supervised.
- Completed restoration design and budget projections, Jim Wilcox.
- Held a Stream Restoration Class for the general public taught by Jim Wilcox of Plumas Corporation with a focus on basic elements of geomorphic restoration techniques. A variety of stakeholders attended, including various agencies, the Sierra Club as well as members of two local Fly Fishing clubs.

### **Fall/Winter 2006**

- Installed Datalogger & Pressure Transducer to monitor stream temperature and flow
- Further collection of baseline piezometer data.

## Winter/Spring 2007

- Collaborate with Sequoia National Forest as they completed the final tasks of Environmental Assessment (EA) which is the current choice of documenting the NEPA process.
- Installed signs for the public describing the problems and restoration process
- Further developed relationship with the grazer/permittee

## Fall 2007

- Further developed our relationship with Sequoia ForestKeeper, a local stakeholder against the project. Negotiated and educated about this work as we accomplished an agreement with them to pull their formal Appeal that was blocking the project.
- **PROJECT INSTALLATION.** This project accomplished three activities: gully elimination using the pond and plug technique, incorporating whole trees into the meadow channel and ponds, and the staging and installation of a rock/vegetation valley grade feature at the lower end of the meadow to address the need to restore the natural meadow and stream water table, stream channel characteristics, and vegetation components.
- Three volunteer days of vegetation work, one volunteer day of Electro-shocking fish and moving them before the work on the project.
- Monitoring of restoration areas weekly for two months, then monthly.

## 2008

- Monitoring of restoration areas monthly
- Shay Overton MA, Geological Engineer, 1 month training with Jim Wilcox onsite

- **Meadow Restoration Class 2008**

**Presented by Fly Fishers for Conservation and the Sierra Nevada Conservancy**

June 9th-13th, 2008, Hume Lake Camp & Big Meadows in Sequoia National Forest

Class description: This is intended to be an intensive course requiring significant preexisting knowledge in applied geomorphology, hydrology, and engineering. The subject matter will be geared for individuals who will actually be developing and implementing meadow re-watering projects. We intend to spread the attendees between participating agencies, including USFS, DFG, NPS and private/watershed entities. Expect coursework to take 10-12 hours per day.

**Purpose:** To provide advanced meadow restoration survey, analysis, and design training, as well as developing budgets and NEPA/CEQA requirements. **When:** June 9th-13th, 2008. Instruction will last 10-12 hours per day.

- Macroinvertebrate collection from ponds, Hobo water temps installed.

## 2009

- Shay Overton spends 30 days with Jim Wilcox for training.
- Continued monitoring of the meadows.
- Calculated monitoring results and created reports. Final reports out.
- Monitoring meetings with Forest Service and funding agencies.
- Attended FFF national conclave and received national conservation award for 2009.
- Seed collection and planting.

## 2008 Class







**Spring 2008**

**For questions please contact Jayne Ferrante, Project manager at 559-437-1818.**